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MC14499

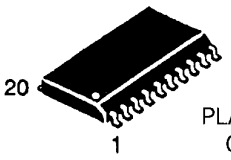
7-segment LED display Decoder/Driver

CMOS

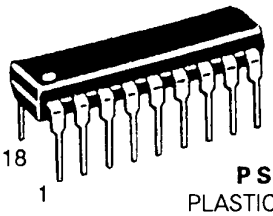
7-SEGMENT LED DISPLAY DECODER/DRIVER

The MC14499 is a 7-segment alphanumeric decoder/driver for use in conjunction with microprocessor (MPU) systems. It is able to drive directly 4-digit displays.

- High current segment drivers on-chip
- MPU compatibility input levels
- Very few external components required
- Wide supply voltage range



DW SUFFIX
PLASTIC PACKAGE
CASE 751D-03



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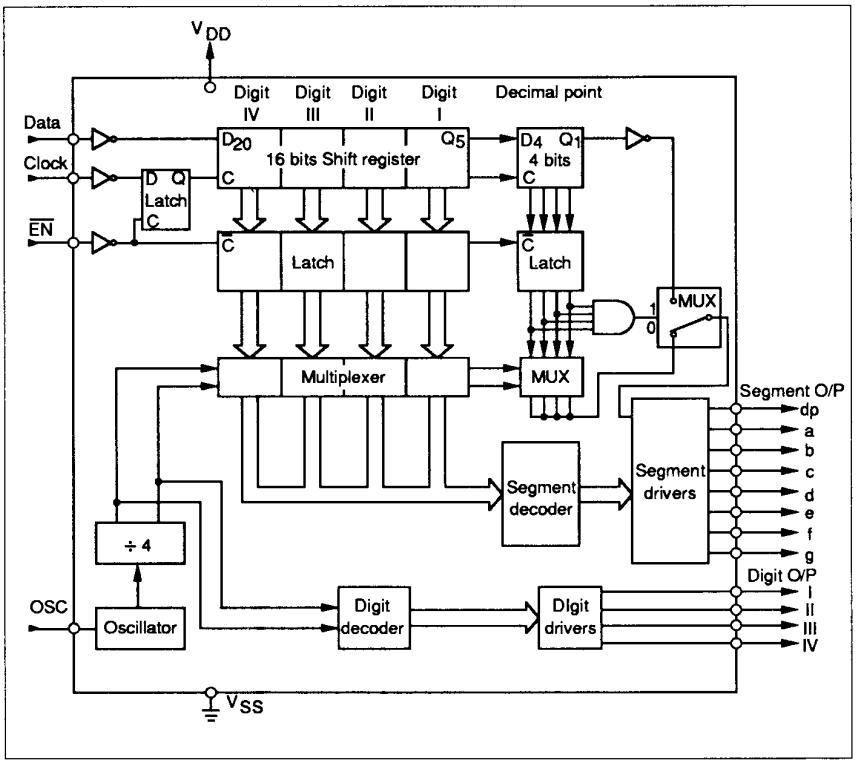
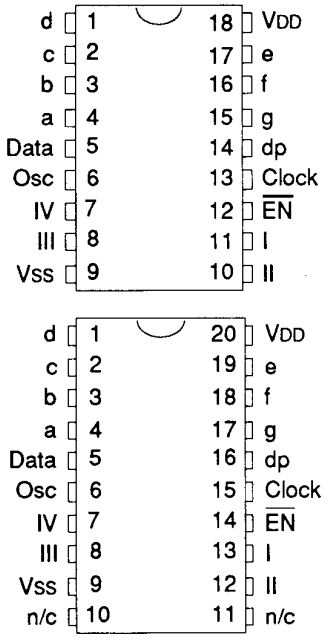
CASE 707

Figure 1. Block diagram



Pin Assignment



MAXIMUM RATINGS (Voltages referenced to V_{SS})

Rating	Symbol	Value	Unit
DC supply voltage	V_{DD}	-0.5 to +7.0	Vdc
Input voltage, all inputs	V_{in}	-0.5 to V_{DD} +0.5	Vdc
Operating temperature range	T_A	0 to +70	°C
Storage temperature range	T_{stg}	-65 to +150	°C

This device contains circuitry to protect the inputs against damage due to high static voltages or electric fields; however, it is advised that normal precautions be taken to avoid application of any voltage higher than maximum rated voltages to this high impedance circuit. For proper operation it is recommended that V_{in} and V_{out} be constrained to the range $V_{SS} \le (V_{in}$ or $V_{out}) \le V_{DD}$.

ELECTRICAL CHARACTERISTICS (T_{SS} = 0 to 70°C)

Characteristic	Pin DIL only	Symbol	Min	Typ	Max	Unit
DC Supply Voltage	18	V_{DD}	4.5		6.5	Vdc
Input level – Low	5, 13	V_{IL}			$0.3 \times V_{DD}$	Vdc
Input level – High	12	V_{IH}	$0.7 \times V_{DD}$			Vdc
Input current (V_{IN} = 0 to V_{DD})		I_{IN}			1	µA
Oscillator input – High level	6	V_{ILO}			$0.2V_{DD}$	Vdc
Oscillator input – Low level		V_{IHO}	$0.8V_{DD}$			Vdc
Input current (V_{IN} = 0 to V_{DD})		I_{INO}	-100		100	µA
Segment Driver Voltage below V_{DD}						
(V_{DD} - V_{SOH})	17, 14					
I_{OUT} = 50 mA	1, 2				1.0	Vdc
I_{OUT} = 10 mA	3, 4				0.8	Vdc
Leakage V_{OUT} = 0	15, 16	I_{OFF}			0.5	mA
Digit drivers						
ON V_{OUT} = 0.8V	7, 8	I_{DOUT}	4			mA
OFF V_{OUT} = 0.5V	10, 11	I_{DOUT}	-0.1			mA
Quiescent current						
V_{IN} = 0, I_{OUT} = 0, C_{OSC} = 15 nF	18	I_Q			1	mA
Maximum power dissipation		P_{MAX}			500	mW

SWITCHING CHARACTERISTICS (V_{DD} = 5V ± 10%, T_A = 0 to 70°C)

Characteristic	Fig	Symbol	Min	Max	Unit
Clock High time	3	t_{CH}	2		µs
Clock Low time	3	t_{CL}	2		µs
Clock Rise time	3	t_{CR}		2	µs
Clock Fall time	3	t_{CF}		2	µs
Enable Lead time	3	$t_{E\ lead}$	200		ns
Enable Lag time	3	$t_{E\ lag}$	200		ns
Data Set-up time	3	$t_{D\ Sup}$	200		ns
Data Hold time	3	$t_{D\ Hold}$	1		µs
Scanner frequency †	5	$1/t_{SCAN}$	50	300	Hz
Osc/Digit Lead time	5	t_{OD}		10	µs
Osc/Digit Lead time	5	t_{OS}		10	µs
Digit Overlap	5	t_{OV}		5	µs

† Capacitor = 15nF

CIRCUIT OPERATION

The circuit accepts a 20-bit input, 16 bits for the four digit display plus 4 bits for the decimal point – these latter four bits are optional.

The input sequence is the decimal point code followed by the four digits, as shown in Figure 2.

In order to enter data the enable input, EN, must be low, = 0. The sample and shift are accomplished on the falling clock edge, see Figure 3. Data are loaded from the shift register to the latches when EN goes high, = 1. While the shift register is being loaded the previous data are stored in the latches.

If the decimal point is used the system requires 20 clock pulses to load data, otherwise only 16 are required.

Cascading

The circuit may be cascaded in the following manner.

If a 1111 word is loaded into the decimal point latch, the output of the shift register is switched to the decimal point driver, see Figure 4. Therefore, to cascade n four digit display drivers a set-up is used which will firstly load the 1111 cascading word:

1 EN = 0

2 Load 20-bits, the first four bits being 1, with 20 clock pulses.

3 EN = 1, to load the latch

4 Repeat steps 1 to 3 (n-1) times

5 (n x 20)-bits can be loaded into n circuits, with 1111 as decimal point word to continue the cascading.

Scanner

The scanner frequency is determined by an on-chip oscillator, which requires an external frequency determining capacitor. The capacitor voltage varies between two trigger levels at the oscillator frequency.

An external oscillator signal can be used, within the recommended operating range of 200 to 800Hz – to avoid flicker and digit overlap. For test purposes this frequency can be increased up to 10kHz.

A divide by four counter provides four non-overlapping scanner waveforms corresponding to the four digits – see Figure 5.

Segment decoder

The code used in this matrix decoder is shown in Figure 6, other codes can be used with a single mask change.

Output drivers

There are two different drivers:

The segment and decimal point drivers; these are NPN emitter followers with no current limiting devices.

The digit output buffers; These are short circuit protected CMOS devices.

A typical application circuit is shown in Figure 7.

Figure 2. Input sequence

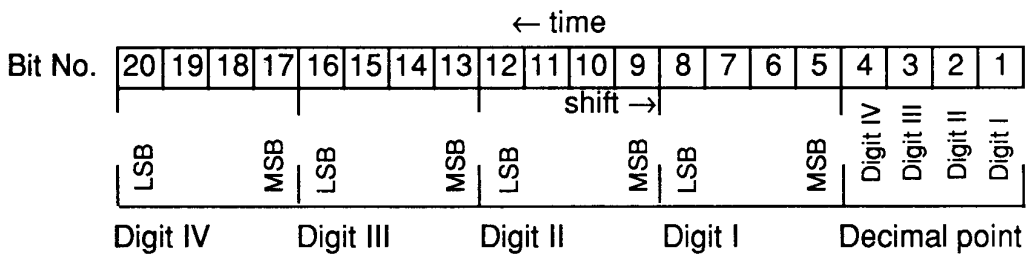


Figure 3a. Serial input, positive clock

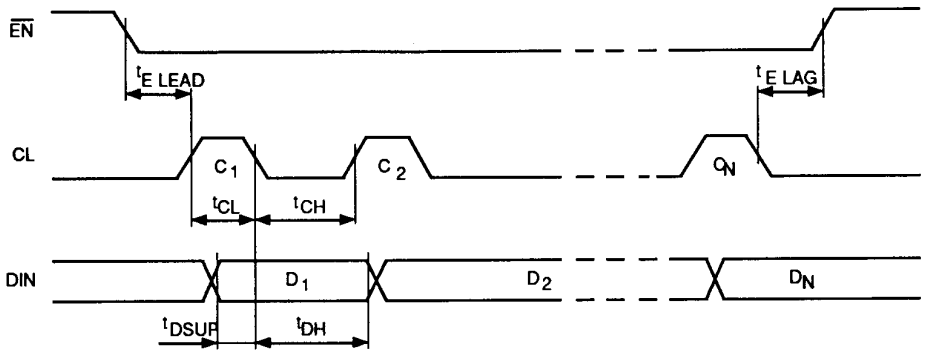


Figure 3b. Serial input, negative clock

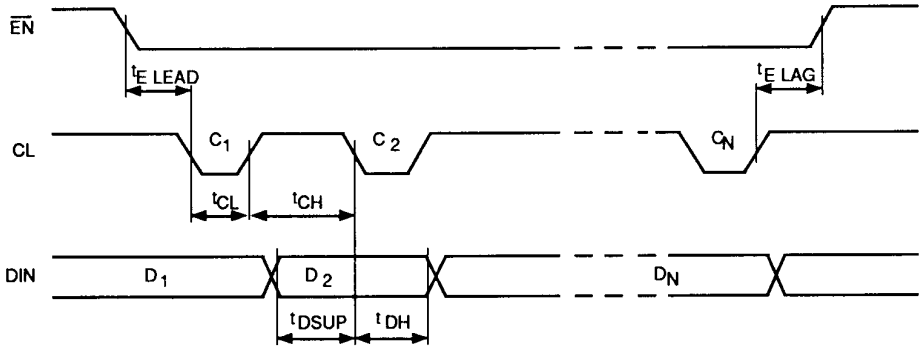


Figure 4. Cascading MC144499s

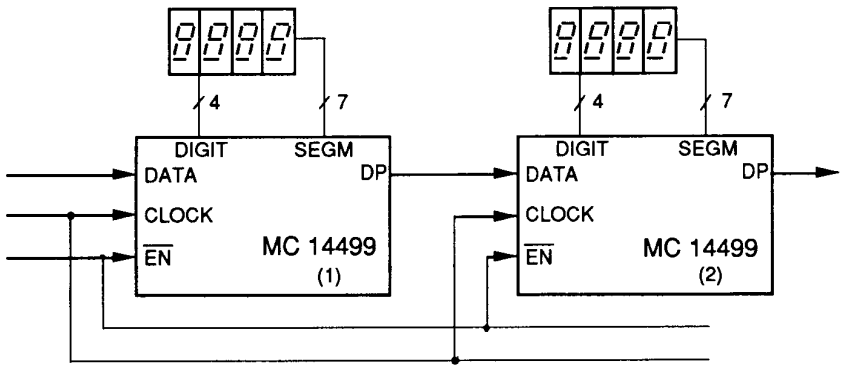


Figure 5. Scanner waveforms

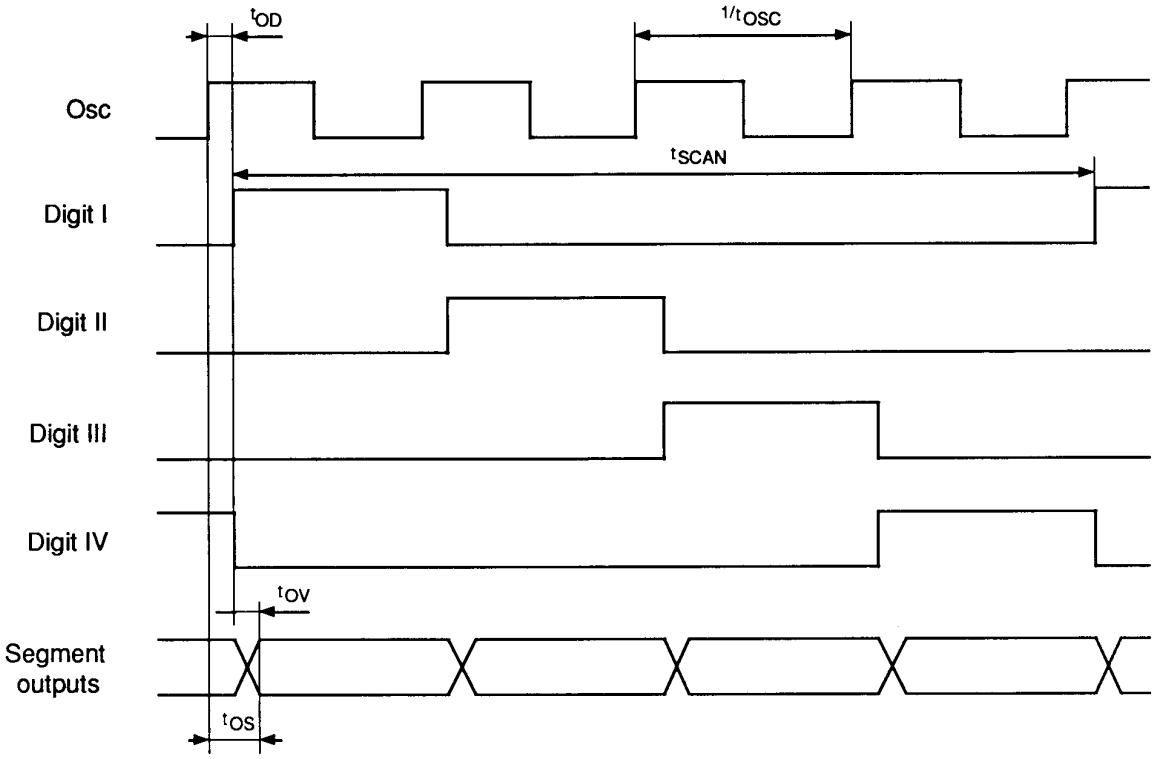
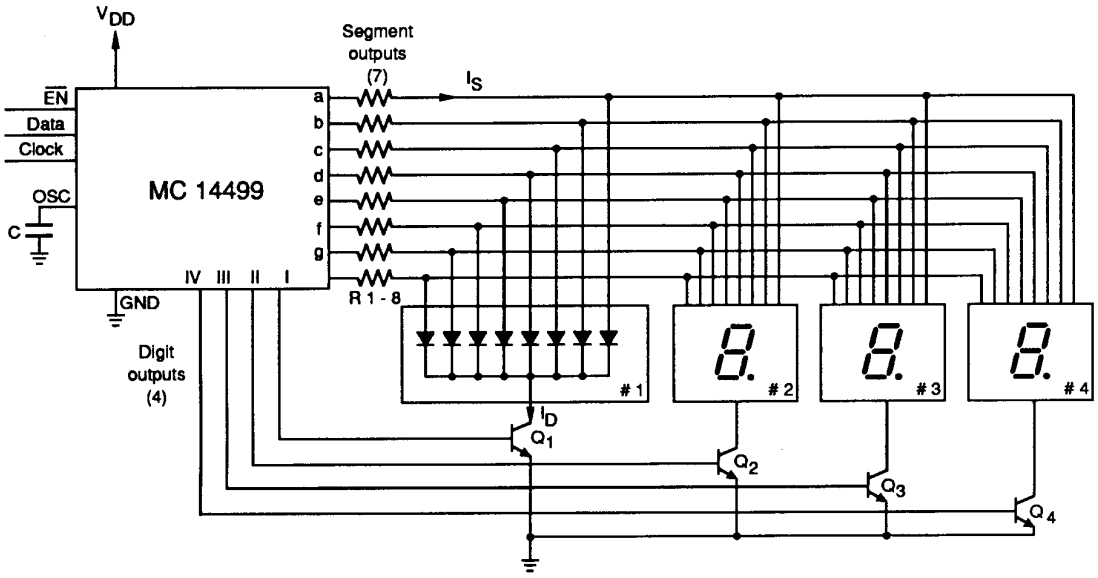


Figure 6. Segment code

0000	0	1000	8
0001	1	1001	9
0010	2	1010	A
0011	3	1011	b
0100	4	1100	C
0101	5	1101	d
0110	6	1110 dash	-
0111	7	1111 blank	

Figure 7. Application example



Q1 – Q4 : BC338 or similar

R1 – R8 : 36 – 82Ω

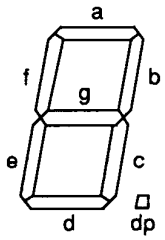
C : 10nF

V_{DD} Typ : 5 – 6V

I_S Max : 40 – 50mA

I_D Max : 8 I_S Max

LED description



Outline dimensions

DW SUFFIX

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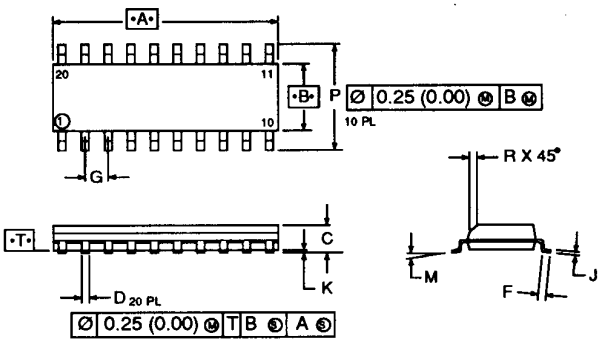

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	12.65	12.95	0.499	0.510
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.50	0.90	0.020	0.035
G	1.27 BSC		0.050 BSC	
J	0.25	0.32	0.010	0.012
K	0.10	0.25	0.004	0.009
M	0°	7°	0°	7°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029

P SUFFIX

PLASTIC PACKAGE
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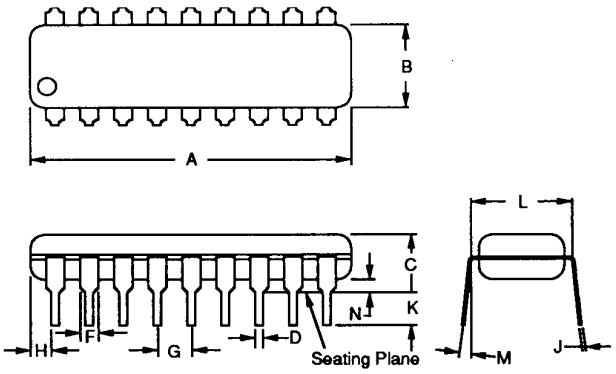

	MILLIMETERS		INCHES	
DIM	MIN	MAX	MIN	MAX
A	22.22	23.24	0.875	0.915
B	6.60	7.11	0.260	0.280
C	4.06	4.57	0.160	0.180
D	0.36	0.51	0.014	0.020
F	1.02	1.52	0.040	0.060
G	2.41	2.67	0.095	0.105
H	1.14	1.40	0.045	0.055
J	0.20	0.30	0.008	0.012
K	3.05	3.56	0.120	0.140
L	7.37	7.67	0.290	0.310
M	0°	10°	0°	10°
N	0.51	1.02	0.020	0.040

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